

The method may further comprise providing a binding oligonucleotide having a selected sequence having at least two portions, the first portion being complementary to at least a portion of the sequence of the oligonucleotides on the second type of nanoparticles. The binding oligonucleotide is contacted with the second type of nanoparticle-oligonucleotide conjugates bound to the substrate under conditions effective to allow hybridization of the binding oligonucleotide to the oligonucleotides on the nanoparticles. Then, a third type of nanoparticles having oligonucleotides attached thereto, the oligonucleotides having a sequence complementary to the sequence of a second portion of the binding oligonucleotide, is contacted with the binding oligonucleotide bound to the substrate under conditions effective to allow hybridization of the binding oligonucleotide to the oligonucleotides on the nanoparticles. Finally, the detectable change produced by these hybridizations is observed.

In yet another embodiment, the method comprises contacting a nucleic acid with a substrate having oligonucleotides attached thereto, the oligonucleotides having a sequence complementary to a first portion of the sequence of the nucleic acid. The contacting takes place under conditions effective to allow hybridization of the oligonucleotides on the substrate with the nucleic acid. Then, the nucleic acid bound to the substrate is contacted with a first type of nanoparticles having oligonucleotides attached thereto, the oligonucleotides having a sequence complementary to a second portion of the sequence of the nucleic acid. The contacting takes place under conditions effective to allow hybridization of the oligonucleotides on the nanoparticles with the nucleic acid. Next, the first type of nanoparticle-oligonucleotide conjugates bound to the substrate is contacted with a second type of nanoparticles having oligonucleotides attached thereto, the oligonucleotides on the second type of nanoparticles having a sequence complementary to at least a portion of the sequence of the oligonucleotides on the first type of nanoparticles, the contacting taking place under conditions effective to allow hybridization of the oligonucleotides on the first and second types of nanoparticles. Finally, a detectable change produced by these hybridizations is observed.

In another embodiment, the method comprises contacting a nucleic acid with a substrate having oligonucleotides attached thereto, the oligonucleotides having a sequence complementary to a first portion of the sequence of the nucleic acid. The contacting takes place under conditions effective to allow hybridization of the oligonucleotides on the substrate with the nucleic acid. Then, the nucleic acid bound to the substrate is contacted with liposomes having oligonucleotides attached thereto, the oligonucleotides having a sequence complementary to a portion of the sequence of the nucleic acid. This contacting takes place under conditions effective to allow hybridization of the oligonucleotides on the liposomes with the nucleic acid. Next, the liposome-oligonucleotide conjugates bound to the substrate are contacted with a first type of nanoparticles having at least a first type of oligonucleotides attached thereto. The first type of oligonucleotides have a hydrophobic group attached to the end not attached to the nanoparticles, and the contacting takes place under conditions effective to allow attachment of the oligonucleotides on the nanoparticles to the liposomes as a result of hydrophobic interactions. A detectable change may be observable at this point. The method may further comprise contacting the first type of nanoparticle-oligonucleotide conjugates bound to the liposomes with a second type of nanoparticles having oligonucleotides attached thereto. The first type of nanoparticles have a second type of oligonucleotides attached thereto which have a sequence complementary to at least a portion of the sequence of the oligonucleotides on the second type of nanoparticles, and the oligonucleotides on the second type of nanoparticles having a sequence complementary to at least a portion of the sequence of the second type of oligonucleotides on the first type of nanoparticles. The contacting takes place under conditions effective to allow hybridization of the oligonucleotides on the first and second types of nanoparticles. Then, a detectable change is observed.

In another embodiment, the method comprises contacting a nucleic acid to be detected with a substrate having oligonucleotides attached thereto. The oligonucleotides have a sequence complementary to a first portion of the sequence of said nucleic acid, the contacting takes place under conditions effective to allow hybridization of the

oligonucleotides on the substrate with said nucleic acid. Next, said nucleic acid bound to the substrate is contacted with a type of nanoparticles having oligonucleotides attached thereto. The oligonucleotides have a sequence complementary to a second portion of the sequence of said nucleic acid. The contacting takes place under conditions effective to allow hybridization of the oligonucleotides on the nanoparticles with said nucleic acid. Then, the substrate is contacted with silver stain to produce a detectable change, and the detectable change is observed.

In yet another embodiment, the method comprises providing a substrate having a first type of nanoparticles attached thereto. The nanoparticles have oligonucleotides attached thereto, the oligonucleotides having a sequence complementary to a first portion of the sequence of a nucleic acid to be detected. Then, the nucleic acid is contacted with the nanoparticles attached to the substrate under conditions effective to allow hybridization of the oligonucleotides on the nanoparticles with said nucleic acid. Next, an aggregate probe comprising at least two types of nanoparticles having oligonucleotides attached thereto is provided. The nanoparticles of the aggregate probe are bound to each other as a result of the hybridization of some of the oligonucleotides attached to them. At least one of the types of nanoparticles of the aggregate probe have oligonucleotides attached thereto which have a sequence complementary to a second portion of the sequence of said nucleic acid. Finally, said nucleic acid bound to the substrate is contacted with the aggregate probe under conditions effective to allow hybridization of the oligonucleotides on the aggregate probe with said nucleic acid, and a detectable change is observed.

In a further embodiment, the method comprises providing a substrate having oligonucleotides attached thereto. The oligonucleotides have a sequence complementary to a first portion of the sequence of a nucleic acid to be detected. An aggregate probe comprising at least two types of nanoparticles having oligonucleotides attached thereto is provided. The nanoparticles of the aggregate probe are bound to each other as a result of the hybridization of some of the oligonucleotides attached to them. At least one of the types of nanoparticles of the aggregate probe have oligonucleotides attached thereto which have a